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WAVETEK





INSTRUCTION MANUAL

SAM 3030

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What Is A SAM 3030?

The SAM 3030 is a Signal Analysis Meter, that improves your efficiency by performing many common level measurements automatically, by a single key push.

The SAM 3030 takes the place of the SAM 3000 in Wavetek's SAM product line. The newer SAM 3030 performs all the functions of the original, and adds two important functions for performing FCC testing.

- The SAM 3030 has a new internal calibration feature, allowing the unit to calibrate with no user interaction. This allows the unit to automatically calibrate before each measurement, ensuring accurate level readings.
- It has a new "sweep" mode, which quickly scans through the channels checking for compliance with the FCC limits, and visually displaying the result. After the sweep is performed, the display presents the results of the sweep, indicating what adjacent channel or level violations occurred.

The SAM 3030 measures RF signal level, hum, $\Delta V/A$, and carrier-to-noise ratio. The four line, backlit LCD displays tuned frequency information and measurement data, as well as a continuous indication of current battery status. A special tilt measurement function allows you to balance an amplifier without constantly retuning the meter. A bar graph and numerical measurement display provide quick, easy to read results.

A SAM 3030 is a rugged, reliable signal level meter with the following features/benefits:

- Quick, easy keyboard tuning for maximum efficiency.
- Backlit LCD readout of tuned frequency or channel and the measurement result for precision measurements.
- Hi/Mid/Low pilot and favorite channel tuning keys for quick tuning to commonly measured frequencies.
- Keyboard selectable channel plans in memory, and two user programmable channel plans make the SAM 3030 adaptable to your system.

The standard SAM 3030 is tunable from 47 to 557 MHz in 125 kHz steps, and measures signals ranging in level from -35 to +60 dBmV.

Options For The SAM 3030 Include:

Sub Band

Tunes from 4.5 to 557 MHz

Sub/UHF Band

Tunes from 4.5 to 920 MHz

SAM 3030 Bag

A padded bag to provide added protection to the instrument

SAM Rack Mount Kit

(K210) Rack Mount Panel Kit

Trunk Hooks

For hanging the instrument from trunk lines

dB μ V Meter

For international use

Standard Accessories Include:

Operating Handbook

Battery Charger

The SAM 3030 has rechargeable NiCad batteries. Please see the section "Battery Charging Basics" for proper charging procedures.

Your SAM 3030 may also be configured for use outside the U. S.. You can select from a number of standard channel plans or custom program two user definable channel plans. See CHANNEL PLANS. Level measurements can be read out in dB μ V. (See SETUP FUNCTIONS)

You can also configure your SAM 3030 for 50/60 Hz, 100/120 Hz and < 400 Hz HUM Tests. See the SETUP FUNCTIONS.

Specifications

Frequency Range

Standard

47 to 557 MHz

Sub Option

4.5 to 557 MHz

Sub/UHF Option

4.5 to 920 MHz

Frequency Accuracy

± 20 kHz (4.5 to 557 MHz) at 25° C

± 50 kHz (557 to 920 MHz)

Tuning Increment

(Up or Down Arrow Key) Can be switched to Channel Sequence or Frequency Sequence tuning.

In Frequency Mode

125 kHz increments *

In Channel Mode

Tunes to Next Video or Audio Carrier

Resolution (I.F.) Bandwidth

280 $\pm$ 50 kHz at 3 dB point

Selectivity

Sufficient to distinguish between two FM signals of equal amplitude 600 kHz apart. Sufficient to measure an audio carrier in the presence of a higher adjacent video carrier 40 dB greater in amplitude.

Subharmonics

>45 dBc anywhere in the tuning bandwidth.

Level Measurement Range

-35 to +60 dBmV

+25 to +120 dB μ V

Warning: Do not connect any RF signal level greater than +70 dBmV (+130 dB μ V) to the RF input of ANY SAM.

Level Accuracy @ 25° C

Amplitude vs. Frequency (Flatness)

± 0.75 dB

Meter Tracking (Linearity)

± 0.75 dB

CW vs. modulation

± 0.25 dB

Temperature Variation

± 2.5 dB from -20 to +50° C

Dimensions

6.5 in (16.51 cm) High x 8.75 in (22.23 cm) Wide x 6.5 in (16.51 cm) Deep.

Weight

7 lb 5 oz (3.4 kg)

Case

Impact and water resistant Lexan®

* Although tuning increment is 125 kHz, the SAM 3030 may be used to measure carriers that are offset from the exact tuned frequency, because the resolution bandwidth of the meter is 280 kHz. This means that a carrier as far away as one half tuning increment (62 kHz) will be well within the resolution bandwidth, and the measurement will be within 0.5 dB.

Battery**Type**

Nickel Cadmium

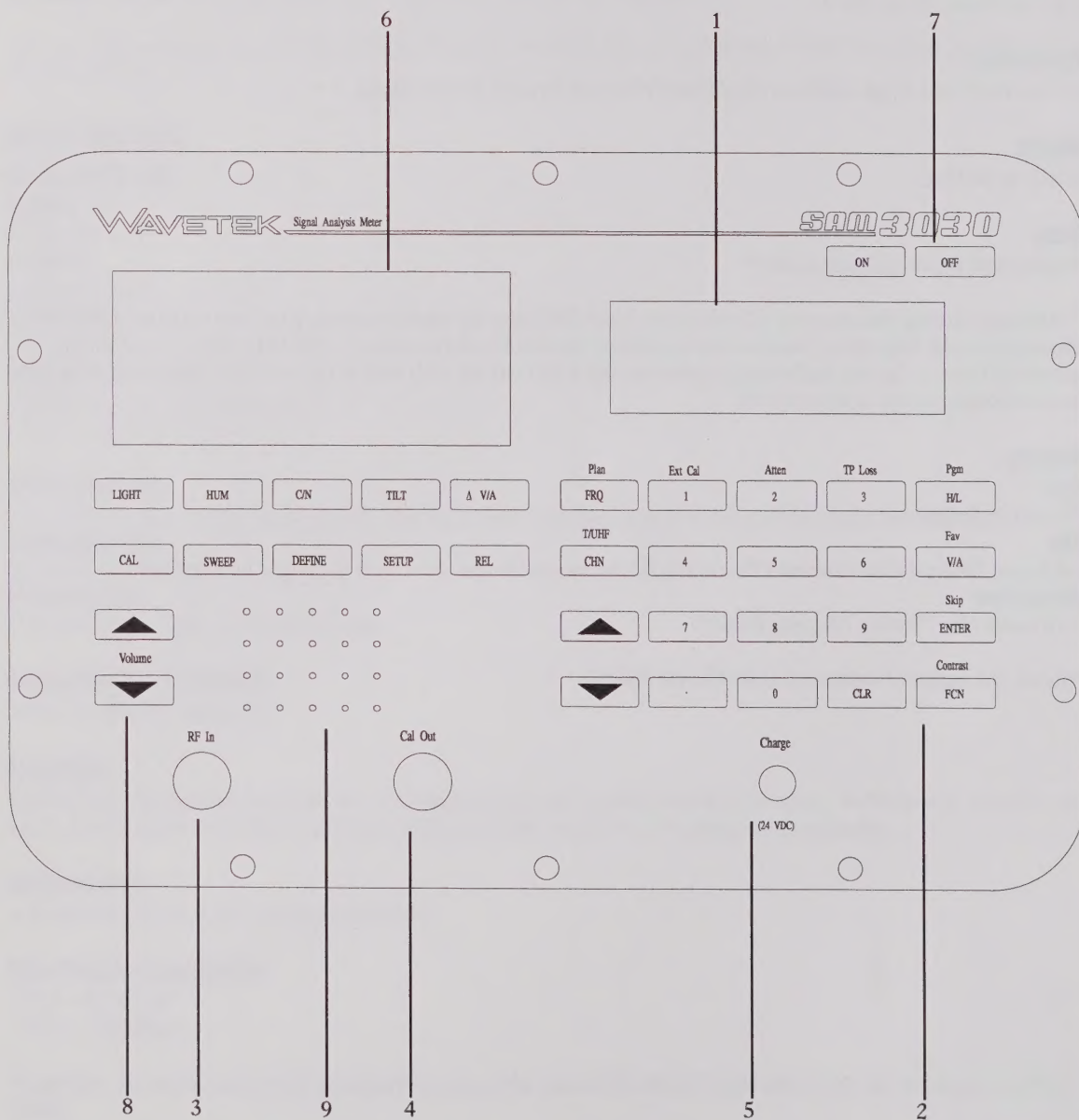
Life

>8 hours, Normal (Intermittent) Operation 4.5 hours continuous (less with backlight and options).

Charge Time

~16 hours (See "Battery Charging Basics")

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Front Panel Drawing

Getting Acquainted With Your SAM 3030

Instrument Controls

Please refer to the front panel drawing to locate the particular numbered item described below.

1. The **LCD (Liquid Crystal Display)** shows the tuned frequency or channel, digits entered via the keyboard, measurement result, and other control information. At power-up, the LCD will display the last tuned frequency or channel of the SAM 3030, and the signal level at that frequency, if the attenuator is in the auto-range position or set to the proper range. A relative indication (three segment bar) of battery level, and the current time will also be displayed, along with the current attenuator setting.
2. The **keyboard**, for tuning by channel or frequency, and initiating test functions. (The digits are entered first then press the channel or frequency key.)
3. The **RF In connector** is for the input signal to be measured.
4. The **Cal Out connector** is for the calibrator output signal, to be connected to the RF In connector before external calibration.
5. The **charge connector**, to be connected to wall mount charger for battery charging. The “**CHARGE**” indicator (red led behind the meter) illuminates when the SAM 3030 is connected to the charger and receiving a charge. The SAM 3030 may be powered by its wall mounted charger in the lab, or other inside environments. *Please see “Battery Charging Basics” before charging the battery.*
6. The **meter** indicates the signal level at the tuned frequency or channel, or gives a relative reading of battery level in the “Setup” mode.
7. The **ON - OFF Keys** are used to turn the SAM 3030 ON or OFF.
8. Audio level **UP and Down arrow keys** are used to control the audio volume level.
9. The **Speaker** sounds the demodulated FM audio signal.

Primary Function Keys

FRQ	Enter numeric digits first, then press “FRQ” to tune by frequency.
CHN	Enter digits first, then press “CHN” to tune by channel.
Up/Down	Press these keys to Increment or decrement tuning by channel or frequency, or to scroll through memory locations, or to adjust LCD contrast.
Numeric	Numerals 0 thru 9 and decimal point “.”.
H/L	Press this key to Toggle tuning between high, mid and low pilot frequencies.
V/A	Press this key to toggle tuning between video and audio carrier in the channel tuning mode.
ENTER	This key is used to select the current option or to indicate that you are finished editing a field.
FCN	Press this key to start a secondary function. Functions are labeled in white letters above the key.
CLR	Press this key to Clear the display when keys are pressed by mistake, or to clear out of test modes.
LIGHT	Press this key to toggle the backlight on/off.
HUM	Press “HUM” while tuned to an unmodulated (CW) carrier, to measure hum.
C/N	Press “C/N” while tuned to an unmodulated (CW) carrier to start a carrier-to-noise measurement.
TILT	Press “TILT” to measure tilt based on levels of High and Low pilot carriers, with High, Mid, and Low carrier levels displayed in bar graph form.
ΔV/A	This key starts the delta V - A mode, automatically displaying the difference in video and audio levels of the selected channel.
CAL	Press “Cal” to internally and automatically connect the internal calibrator to RF In and calibrate the SAM 3030.
SWEEP	Press to start the sweep analysis of the spectrum.
DEFINE	This key starts the definition of a test plan. The test plan is used when SWEEPing.

SETUP	Press this key to setup the auxiliary meter features: 1. Calibrator On Mode: used to measure cable loss or device loss using the meter's internal calibrator as a signal source (10.0 dBmV @55.2 MHz) 2. Shutdown Time: the time the unit will wait before automatically shutting down when no keys are struck 3. Level Units: dBmV or dBμV 4. Channel Sequence: the order in which channels are tuned when using the up and down arrow keys, either numeric order, or in frequency order 5. Hum Filter Frequency: either 50/60, 100/120, or <400 Hz
REL	This function uses the current level as reference, and displays all subsequent measurements as the difference from the reference level.

Secondary Functions

Secondary functions are two keystroke functions, **FCN** followed by the desired function.

Plan	Press "FCN" "Plan" to select a channel plan.
Ext Cal	With the Cal Out connected to the RF In, press "FCN" "Ext Cal" to perform an external calibration. This is useful to calibrate out test cable loss.
Atten	Normally, the SAM 3030 is used in auto attenuation mode. To manually switch between 0, 20, 40, and 60 dB, Press "FCN" "Atten" followed by the Up/Down keys. The amount of attenuation is shown on line 4 of the LCD display. Be sure to return the unit to the Auto mode after making a manual measurement. In the "Auto" selection, the meter automatically selects the best setting for measurement.
TP Loss	Press this key to define the current test point loss. The defined test point loss is added to all measured values prior to display or printout.
Pgm	Press this key to program favorite channels and/or High/Mid/Low pilot frequencies.
T/UHF	Press "FCN" "T/UHF" after entering the digits for the channel number, to tune the SAM 3030 to a Sub (T) or UHF channel.
Fav	Press this key to recall stored favorite channels or frequencies.
Skip	This key allows the user to delete channels when in the Define mode. Other uses of this key are explained on the LCD as part of a prompt's text.
Contrast	This function allows the user to adjust the display contrast.

Setup Functions

Calibrator ON	Press "SETUP", use "↑" or "↓" to display "CALIBRATOR ON MODE" and press "ENTER" to turn on calibrator output (10.0 dBmV @55.2 MHz). Press "CLR" to return to normal operation.
Shutdown Time	Press "SETUP", use "↑" or "↓" to display "Set Shutdown Time" and press "ENTER". This is the time the unit will wait before automatically shutting down when no keys are struck.
Level Units	Press "SETUP", use "↑" or "↓" to display "Set Level units" and press "ENTER" and select ↑↓ for dBmV or dBμV, "CLR".
Channel Sequence	Press "SETUP", use "↑" or "↓" to display "Set Chan Sequence" and press "ENTER". This is the order in which channels are tuned when using the up and down arrow keys, either numeric order, or in frequency order.
HUM Frequency	Press "SETUP", use "↑" or "↓" to display "Set Hum Filt Frq" and press "ENTER" and select ↑↓ for 60/120 or 50/100 Hz. This sets the base frequency to either 50 or 60 Hz for use internationally or in the US.
Battery Check	Press "SETUP", analog meter displays battery level.
Software Version	Press "SETUP" and the SAM 3030 software version will be displayed on the upper right corner of the LCD.

Press "CLR" again to exit the Setup Function Mode

Battery Charging Basics

A three segment "BATT" indicator is given on the LCD during most measurement modes. When three segments are displayed, the battery charge is high; when two segments are displayed the charge is medium; and when one segment is displayed the charge is low. The charge condition may also be tested by pressing "SETUP", and reading the analog meter. The battery should be recharged when the meter doesn't deflect to the "GOOD" region of the battery scale.

When you first receive your SAM 3030 the NiCad battery may have a nominal charge, and it should be charged before using it. A full charge lasts approximately 8 hours under typical usage (intermittent on/off). In continuous operation with the backlight and other options decrease the battery life. The SAM 3030 may be used while recharging, but the recharge time will be increased from 16 hours (overnight) to 36 hours. Do not charge the SAM 3030 longer than 16 hours, as this can degrade battery performance and cause battery leakage. The SAM 3030 may be connected to the charger *with the instrument "on"* indefinitely without harm to the battery. If the SAM 3030 has a UHF option, it will not charge while operating. Hum measurements are affected by the charger, and accuracy of these measurements may be degraded by up to 0.5%.

Warning: Use only the charger (Wavetek part number 1219-40-0267) supplied by Wavetek. Chargers used with SAM Jr. are not compatible with the SAM 3030. Although another charger plug might fit into the SAM 3030 Charge connector, use of any other charger than the one provided for the SAM 3030 is not approved by Wavetek, and may result in serious damage to the SAM 3030.

Replace the SAM 3030 battery pack only with the SAM 3030 battery pack supplied by Wavetek (part number 1219-40-0269). The SAM 3030 battery pack has a built-in current limiting device to provide protection against fire hazard, that is not typically found in battery packs available elsewhere.

Battery packs should be charged at a temperature of 65 to 75 degrees Fahrenheit. SAM 3030's have "trickle or float" battery charging circuit. The meter may remain connected to the specified Wavetek wall-charger continuously, with no degradation in battery performance, as long as the instrument is turned "on".

Note: SAM 1000/2000, SAM 1500, SAM 3000 & older LineSAM wall-chargers are not compatible with the SAM Jr.

Battery packs should be stored at 65 to 75 degrees Fahrenheit. The charge acceptance of NiCad batteries decreases temporarily after long-term and/or high temperature storage conditions, but will return to normal after 1 -3 charge/ discharge cycles.

NiCad batteries can be charged and discharged several hundred times (approx. 500) under normal usage conditions. A battery pack has reached the end of its life when its capacity falls below 80%. The capacity of NiCad battery packs decreases with decreasing temperature. The average pack will lose approximately 35 to 40% of its room temperature capacity at -5 degrees Fahrenheit.

How To Tell The SAM 3030 Your Channel Plan (Standard, HRC, etc.)

The SAM 3030 may be tuned by entering a specific channel number and pressing the channel key. The frequency that corresponds to the channel number depends on the channel plan the SAM 3030 is set up to use. A channel plan from the following list may be used:

NCTA Plan	JRD HRC Plan	GMBH - 2
NCTA IRC Plan	Pal B/G	Hong Kong
NCTA HRC Plan	Pal A - UK	India
JRD Plan	Belg - Ap	Custom Plan 1
JRD IRC Plan	GMBH - 1	Custom Plan 2

To set the SAM 3030 up for one of these plans, press “FCN” then “Plan”. The current channel plan will be displayed. To change the channel plan simply press the “↑” or “↓” key until the code for the desired channel plan is displayed. Press the “CLR” key and the SAM 3030 will now tune according to the selected channel plan.

How To Program A Custom Channel Plan

To program a custom channel plan, first press “FCN” and “Plan”. The display will show the current channel plan. Press the “↑” or “↓” keys until the display shows “CUSTOM PLAN 1” or “CUSTOM PLAN 2”. Next, enter the custom plan programming mode, by pressing “FCN” and “Pgm”. The display will show dashes to indicate frequency and “CH 0V” (meaning channel 0 video frequency). [If you would like to skip channel 0, press the “↑” key to increment the channel to the first channel number you would like in your plan]. Enter the video frequency for the indicated channel and press the “FRQ” key. Next, program the audio carrier frequency for this channel by pressing the “V/A” key, entering the audio carrier frequency, and pressing the “FRQ” key. Repeat this process until all of the desired channels are programmed. To exit the custom plan programming mode press “CLR”.

Note: It is not possible to select a custom plan that has not had at least one channel programmed. If there are no programmed channels when exiting the custom plan programming mode, a “CUSTOM EMPTY” error message will be displayed. Press “CLR” to return to the plan mode.

To delete a channel, enter the custom plan programming mode by pressing “FCN”, “Plan”, pressing the “↑” or “↓” keys until the desired custom plan is shown, then pressing “FCN” and “Pgm”. Next press the “↑” or “↓” keys until the channel to be deleted is displayed. Press “FCN” “Skip” and both the video and audio carriers for this channel will be deleted. Press the “↓” and “↑” keys until the next channel to be deleted is shown and press “FCN” “Skip”. Repeat this process until all of the undesired channels are deleted. Exit the custom plan programming mode by pressing “CLR”. Exit the channel plan selection mode by pressing “CLR” again.

How To Program Your Hi/Mid/Low And Favorite Channels

The SAM 3030 will tune to a preprogrammed Hi, Mid, or Low channel when the “H/L” key is pressed, and will show the levels of all three channels and the tilt when “TILT” is pressed. The SAM 3030 will also tune to preprogrammed “favorite channels” when the “FCN” “Fav” keys are pressed.

To program Hi/Mid/Low and favorite channels, first press “FCN” “Pgm”. The display will show the currently configured “low” channel or frequency. You may change it by entering the digits and pressing “CHN” or “FRQ” as appropriate. Scroll through mid, hi, and the favorite channels using the up arrow key and program as desired. Press “CLR” when programming is complete to return to normal operation.

How To Select A Frequency For Measurement -Tuning Your SAM 3030

One of the most important, and beneficial features of the SAM 3030 is its quick tuning. You can tune by frequency, by channel, by favorite channel, or, with the press of a key to your high, mid and low pilot or test carriers.

Tuning By Frequency

To tune to any specific frequency, you simply enter the digits of that frequency and then press the “FRQ” key. For example, if you want to tune to 150 MHz, you enter 1, 5, and 0, then press the “FRQ” key. The display will show the digits as you enter them, and after the “FRQ” key is pressed it will show the tuned frequency: 150.000. If you want to tune around this frequency, for instance to find the frequency at which the meter is peaked, you simply press the “↓” or “↑” key to increment or decrement the frequency in 125 kHz increments. Hold down the arrow key to continuously tune.

If you want to know what channel is near a given frequency, simply tune to that frequency and press the “CHN” key. The SAM 3030 will tune to the nearest video or audio carrier in the channel plan for which the SAM 3030 is configured, and the display will show the channel number.

If you are unable to tune the SAM 3030 to the exact frequency of the test carrier (for instance a carrier frequency of 150.062 MHz), tune to the nearest tunable frequency (in this instance 150.000 MHz). The test signal will be well within the 280 kHz resolution bandwidth of the meter and the accuracy of the measurement won't be off by more than 0.5 dB from the specified accuracy.

Tuning By Channel - Channel Order

The SAM 3030 allows you to tune using the arrow keys in either channel sequence or frequency sequence. In channel sequence, the order of channels tuned (by pressing the Up key) is 2, 3, 4, 5, 6, 7, 8, 9,...99. In frequency order, the sequence would be (assuming that the NCTA channel plan is selected) 2, 3, 4, 5, 6, 95, 96, 97, 98, 99, 14, 15.... The latter is more useful in monitoring tests on adjacent channels per FCC regulations, although the SAM 3030 automatically determines the correct adjacent channel when SWEEPing.

To tune to any specific channel, you simply enter the digits of that channel and then press the "CHN" key. For example, if you want to tune to channel 14, you enter 1 and 4, then press the "CHN" key. The display will show the digits as you enter them, and after the "CHN" key is pressed it will show the tuned channel: CH 14. The SAM 3030 will be tuned to either the video or the audio carrier of channel 14, depending on the last channel carrier setting (a "V" or "A" will be displayed next to the channel number to indicate which carrier). To toggle the tuning from the video to the audio carrier, or vice versa, simply press the "V/A" key. The "V/A" key is effective only when the SAM 3030 is in the channel tuning mode (a channel is indicated on the LCD). Pressing the "↓" or "↑" key will tune the SAM 3030 to the next higher or lower channel respectively. Holding the arrow key down will continuously tune by channel.

If you want to know what frequency corresponds to a given channel number, simply tune to that channel and press the "FRQ" key. The video or audio carrier frequency will be displayed, depending on the last channel carrier setting (a "V" or "A" will be displayed next to the channel number to indicate which carrier).

Tuning By Channel - Frequency Order

To change from channel order tuning to frequency order, simple access the SETUP function, SET CHAN SEQUENCE. Choose the frequency option and the unit will then tune from channel to channel in frequency order.

Tuning In The Sub Or UHF Bands

To tune to a Sub or UHF band channel, enter the channel digits, then press "FCN" "T/UHF".

Hi/Mid/Lo Channel Tuning

To tune quickly to the preprogrammed high, mid, and low channels, simply press the "H/L" key. The SAM 3030 will tune from low to mid to hi channel with the (LOW, MID, HI) channel designation indicated in the lower left corner of the LCD.

Favorite Channel Tuning

To quickly tune to any of the favorite channels, simply enter the digit corresponding to that channel and press "FCN" "Fav". To tune through the 8 preprogrammed favorite channels, after pressing "FCN" "Fav" press the up arrow key. The currently tuned favorite channel designation will be shown in the lower left corner of the LCD. Press "CLR" to return to the normal channel/frequency tuning mode.

How To Measure A Test Signal

A test signal may be at any frequency, for example a hum carrier at a non-standard channel frequency, a signal generate test signal or a calibrator at 150 MHz (from a SAM I or III). The test signal should first be connected to the RF In connector on the SAM 3030. Tune the meter to the test carrier frequency by entering the frequency digits (for example: "1, 5, 0") and then press the "FRQ" key. The LCD display will indicate the digits as you enter them, then the tuned frequency (for example: "150.000") after the "FRQ" key is pressed. Set the attenuator switch to the setting that makes the meter read somewhere in the middle of the scale. If the attenuator is in the "Auto" position the meter will automatically find the best attenuator setting for measurement.

The attenuator setting is given on the bottom line of the LCD, and this setting determines which meter scale to use for measurement (see the table below). The meter is read by matching the attenuator setting (60, 40, 20, or 0) with the number indicated on the right-hand side of the scale. Each segment on the meter scale equals 1 dB.

SWITCH SETTING	dBmV		dBμV	
	METER RANGE		METER RANGE	
0 dB	-35	to 0 dBmV	+25	to 60 dBμV
20 dB	-15	to +20 dBmV	+45	to 80 dBμV
40 dB	+5	to +40 dBmV	+65	to 100 dBμV
60 dB	+25	to +60 dBmV	+85	to 120 dBμV

Test Point Loss Compensation

You may configure the SAM 3030 to automatically add the test point loss to all signal level measurements. This gives you the amplitude of signals on the system without the need to mentally add the test point loss. (This assumes that the specified test point loss is accurate). To set up the test point loss compensation feature, press “FCN” “TP Loss”, enter the loss in dB, and press “ENTER”.

When And How To Calibrate Your SAM 3030

The SAM 3030’s RF circuitry is naturally subject to changes in temperature, and these changes tend to cause amplitude measurement variations. These variations may be easily compensated by calibrating the SAM 3030 at or near the temperature at which it will be used. The convenient built-in calibrator makes calibration a simple process. Pressing “CAL” switches to this internal calibrator and calibration is executed.

To externally calibrate the SAM 3030, simply connect the calibrator output (Cal Out) to the RF input (RF In) with a 3 to 4 foot jumper. Next, press “FCN”, “Ext Cal”. The LCD will show “CALIBRATION”, and the meter will deflect to 10 dB below full scale. When calibration is complete, the meter will return to normal operation, and the meter is calibrated.

The calibrator is a precision 55.2 MHz oscillator, which is switched “on” when the Cal function is implemented. The RF input is measured, and this measurement is compared to the known calibrator level. The SAM 3030 is then recalibrated to the known calibrator level.

The calibrator may be activated for use in other tests by pressing “SETUP” “ENTER”. This function is provided to enable quick tests of component loss and isolation as described in the application section of this manual. To avoid possible measurement procedure errors, the meter remains tuned to 55.250 MHz while the calibrator is “on”. This also ensures that the calibrator is not left “on” accidentally, which would shorten battery life.

An MC-50 400 should not be used to check the SAM 3030’s peak detector. (Peak detector operation may be verified by turning modulation on and off to ensure that the meter reads both modulated and unmodulated signals consistently and accurately). The SAM 3030 peak detector is designed to measure horizontal sync suppression scrambled signals accurately, based on the 60 Hz vertical interval, and for this reason doesn’t read accurately when the only modulation present is a simulated 15,750 Hz modulation.

Using the Automatic Sweep Function

The SAM 3030 can quickly measure all the active channels in a test plan and determine which channels or levels fail FCC test requirements. There are two major aspects to the sweep feature: a) the sweep itself, and its display, and b) the setup and checking of limits.

Sweep activation is simple: press the “SWEEP” key, and then choose which of the 5 test plans to sweep. Sweep mode displays three consecutive channels on lines 2-4 of the LCD display, scrolling them “off the top”. As you observe the sweep activity, you can visualize the spectrum for gross errors. As it sweeps, each channel’s V and A carriers are represented by a dual line display, where the top line represents the video level, and the bottom line represents the audio level:

CH 2 =====
CH 3 =====
CH 4 =====

Turning this illustration on its side renders it closer to the traditional spectrum. However, it is not the principal function of Sweep Mode to display this graph, but to perform limit and other tests on the data - analysis that is much more accurate and easier to document than the human eye's capabilities.

When the sweep is finished, the highest and lowest measured video levels and delta V/A levels are displayed, along with an overall PASS/FAIL status. If any failures were found, use the arrow keys to scroll through the failing channels. Error messages accompany each channel's display:

1. Vid ↓ :video is below the defined min video limit
2. Vid ↑ :video is greater than max video as defined by the max video deviation limit
3. DVA ↓ :the channel's delta v/a ratio is below the defined minimum delta v/a ratio
4. DVA ↑ :the channel's delta v/a ratio is above the defined maximum delta v/a ratio
5. C-C ↑ :the video channel to adjacent channel difference is greater than the define maximum channel to channel limit

The Sweep function as described would have limited usefulness in situations where tilt is added to the system. Therefore, the SAM 3030 has the capability to subtract out the measured tilt in a system before displaying a channel's levels and checking the level against the defined limits. This feature is turned on/off as part of the usual sweep setup.

Sweep limits are setup as part of a test plan's definition. This gives you the capability to setup 5 different sets of limits, where each set is useful in a different situation. In addition to the video, delta v/a, and channel to channel limits, each plan also allows the user to turn on/off the sweep tilt compensation. See the Define section for details of how to setup a test plan's sweep limits and tilt compensation.

Setting Sweep Limits And Tilt Compensation

The sweep function uses the defined test plan to perform the system sweep. As each channel is measured, it is checked against the user's defined limits for video level, delta v/a, and channel to adjacent channel video deviation. These limits are set by default to the FCC limits, but the user can re-define these as desired as part of each test plan definition. The user can thereby check his system at various points, using limits defined specifically for that point. Finally, the user can also specify that measurements made while SWEEPing are normalized to the measured system tilt. This gives the user the ability to use SWEEP even at an amplifier which introduces tilt into the system. By turning on tilt compensation, the user can determine if the amp output is appropriate to enable signal levels to meet FCC specs at the end of a cable run.

To set SWEEP limits, use the arrow keys to select the SET SPEC LIMITS option under Define for the desired test plan. Then set the limits for:

1. minimum video level
2. maximum video deviation from highest to lowest measured video channels
3. minimum delta v/a
4. maximum delta v/a
5. maximum video channel to adjacent channel deviation

To set SWEEP tilt compensation, use the arrow keys to select the SET SWP TILT COMP option under Define for the desired test plan.

Defining (Teaching) A SAM 3030 Test Plan

The first step to SWEEPing is to "teach" the SAM 3030 test plan (routine). This teaching process involves identifying the channels to be measured in SWEEP mode. The first step is to enter the test definition mode, by pressing "DEFINE", then entering the digit (1-5) corresponding to the plan to be defined. The channels

may be “learned” automatically (AUTO LEARN), or given to be all channels between a specified range (CHANNEL RANGE).

Auto Learn is a good choice if it is possible to connect a system test point to the RF input. If you select AUTO LEARN (press ENTER), the SAM 3030 will tune through the current channel plan (NCTA, Jerrold, or Custom) and build all of the carriers present on the RF input into the test plan.

If there is no test point available to connect to the SAM 3030, CHANNEL RANGE would be a good choice. This enables you to enter the low and high end channels, and the SAM 3030 will measure these and all channels in between (from the currently configured channel plan (NCTA, Jerrold, Custom, etc.)).

Before leaving the definition mode, the test plan that you’ve defined may be edited to add or delete other channels, using SINGLE CHANNEL +/-.

Then select either Yes (to perform tilt compensation) or No (to disable tilt compensation). The first channel in the plan will be displayed, along with its present amplitude, and a sign indicating the nature of the test to be performed at this frequency, as indicated in the following table:

Sign	Definition
–	not in plan (not measured)
+	Signal will be measured

To add a channel to the plan, tune to that channel and press “ENTER”. To delete a channel from the plan, tune to that channel and press “FCN” “Skip”. Press “CLR” to return to normal operation.

Now that the test plan is defined, it can be used for SWEEPing.

How To Set-up Headend Levels

The SAM 3030 has three special features to improve headend alignment efficiency: The Reference Level Function, the Delta V - A Function (video/audio carrier ratio), and the tune by frequency order feature. These features simplify the process of aligning the headend for a flat output. The first step is to measure and adjust the channel 2 video carrier to the desired amplitude. Next, press “REL”. This makes the channel 2 signal amplitude the reference for the other carriers, and all subsequent measurements while in this mode will be “normalized” to the channel 2 carrier amplitude. The display will show 0.0 dB, unless the signal amplitude changes. You may now step through the channels using the up arrow key, and adjust each modulator or processor until the level reads 0.0 dB. After this is done, all of the video carriers will be aligned to the same level as the channel 2 video carrier, and the audio carriers may be measured and adjusted as necessary. Press “CLR” to return to normal operation.

To set the audio carriers, tune to channel 2 and press “DV/A”. The difference between the channel 2 video carrier and the channel 2 audio carrier will be displayed. **(The FCC guidelines suggest a minimum of 6.5 dB and a maximum of 17 dB for this ratio).** After adjusting channel 2 audio signal amplitude, press the up arrow key to tune to the next channel in sequence, and the display will show the video/audio carrier ratio for that channel. Continue this process until all of your channels are aligned. Press “CLR” to return to normal operation.

How To Measure System Tilt - Balancing An Amplifier

A cable system is designed for unity gain, and each type of amplifier (trunk, bridge/line extender) output should be as close to identical as is physically possible. The amplifiers are set up with specified levels for signals at the high and low end of the spectrum that are used for Automatic Gain Control (AGC) or Automatic Slope Control (ASC). In the amplifier balancing process, these signals are measured and adjusted to specification. Before making an adjustment, be sure that there is not a problem in the system that *should not be compen-*

sated with an adjustment but a repair is needed. If the signal measured is more than a couple of dB from where it should be, some investigation should be done to determine the source of the discrepancy.

To balance the amplifier, with the AGC and ASC switched “off”, first measure the high pilot level and adjust it to the specified level with the gain control. The gain control tends to affect the overall amplitude throughout the spectrum equally. Then measure the low pilot level, and adjust it to the specified level using the slope control. The slope control affects the low end of the spectrum more than the high end. Tune back to the high end and repeat this process - the controls interact with each other - until the pilots are “balanced”. Then switch “on” the AGC and ASC wait a moment to measure the signal levels with AGC and ASC activated.

The SAM 3030 makes this process simple through the provision of a Hi/Lo (H/L) pilot tuning key. Pressing this key toggles the tuning through the configured high end, mid and low end channels. (See How To Program Your Hi/Lo Pilots And Favorite Channels). To further simplify the process the “TILT” feature provides an LCD bar graph readout of the low, mid and high pilot levels (press “FRQ” to toggle the numerics from channel or frequency to measured carrier levels) and the slope (difference between high and low pilot levels). To activate this function, press “TILT”. This feature makes it possible to balance the amplifier without repeatedly tuning the meter.

How To Measure Hum

Hum is defined by the NCTA Recommended Practices as “amplitude modulation at power frequencies”. The SAM 3030 measures percentage of hum on a CW carrier. The first step in measuring hum is to tune to the CW test carrier frequency. Next, press “HUM”. The tuned frequency, the percent hum, and the hum component being measured are displayed on the top line of the LCD. You may scroll through 60 Hz, 120 Hz and <400 Hz by pressing the up or down arrow key. The ability to discern which component (60 or 120 Hz) is contributing the most to the hum modulation. A 60 Hz modulation component suggests a possible corroded connector, a 120 Hz component tends to indicate a possible failure related to the DC supply in the amplifier - possibly a capacitor going bad and aggravating the ripple.

For international use, the Hum filter frequency can be set to a base frequency of 50 Hz via the SETUP feature. (See Setup Functions). Once this is done, the hum filter frequencies are 50, 100, and <400 Hz.

How To Measure Carrier-To-Noise

The SAM 3030 has a special Carrier-to-Noise measurement feature. This measurement is simply a comparison in amplitude between the reference signal and the noise. The reference carrier amplitude must be at least +20 dBmV at the RF input of the SAM 3030 to provide an adequate measurement range for measuring system noise as opposed to instrument noise. The noise measurement automatically corrects to reflect a 4 MHz bandwidth, peak detection vs. average noise, and IF impulse bandwidth.

To make a C/N measurement, first choose a good frequency for the measurement. The noise measurement **must** be made at least 2 to 2.5 MHz from any other carrier on the system. The video carrier for channel 2 is commonly used for a reference carrier, and the noise is then measured 2 to 2.5 MHz away from the carrier. For the purpose of this example, let's assume the measurement will be made at channel 2 and the video carrier frequency is 55.250 MHz. First, tune the meter to 55.250 MHz. Next, press “C/N”. The display will show the noise measurement correction factor. Tune down to 53 MHz. Tune up and down using the “↑” and “↓” arrow keys to find the highest C/N reading, and to assure that you are not measuring a beat (intermod) product.

How To Measure Leakage

Leakage signals may be measured using the SAM 3030, and a Wavetek RD-1 tunable dipole antenna. The RD-1 has a built-in 16 dB preamplifier to boost the received signal for measurement on the SAM 3030. A loop-through provision is made on the RD-1 to permit the use of a bandpass filter prior to the pre-amplification of the leakage signal to limit intermod effects that result from measuring a low level signal in the presence of other signals at much higher levels.

The SAM 3030 should be tuned to the leakage measurement frequency, usually a video carrier in the mid-band (108 - 140 MHz). The dipole antenna elements should be adjusted to the correct length to correspond to the measurement frequency (a chart is given on the back page of the RD-1 Manual). The FCC prescribes a measurement procedure for leakage that should be followed. This specifies that the leak should be measured at a distance of 10 feet, with the antenna 10 feet off the ground, and 10 feet from any reflecting surface. Rotate the antenna to obtain the peak measurement, and record the measurement in your leakage log.

To convert the level measurement from dBmV to $\mu\text{V/m}$ use the following equations (be sure to subtract the 16 dB gain of the RD-1 preamplifier first):

First convert from dBmV to μV
 $E_{\mu\text{V}} = \text{inverse Log (dBmV/20)} * 1000$
 Next find $\mu\text{V/m}$
 $\mu\text{V/m} = 0.021 * E_{\mu\text{V}} * F$
 where: $E_{\mu\text{V}}$ = Receiver input terminal voltage in μV
 F = Tuned measurement frequency
 $\mu\text{V/m}$ = Measured field strength in $\mu\text{V/m}$

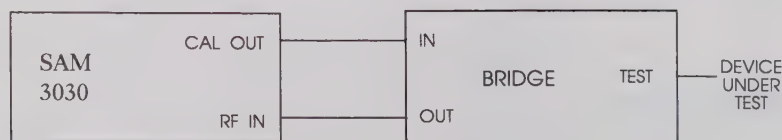
How To Measure Return Loss

Return loss (usually specified in dB) is the ratio of the original signal to the reflected signal at a junction point in a circuit. Typically, this is at a coaxial cable connection to the input or output of a piece of equipment. With a perfect connection (which, of course, does not exist because of impedance mis-matches due to inductive, resistive, and capacitive factors, two of which are frequency dependent), all the signal is transmitted and none is reflected (return loss = infinity dB). At the other extreme, if a transmission line (coaxial cable) is terminated either in either a short or an open, none of the signal is transmitted and all of it is reflected (return loss = 0 dB). The greater the return loss figure (specified in dB), the better the connection and transmission of the signal through the connection.

The return loss specification describes quality of the connection, and also the deviation of a device input or output from its nominal impedance (75 ohms for CATV applications) as well as the voltage standing wave ratio (VSWR). VSWR is the ratio of the maximum and minimum voltages on the transmission line created by the interference of the original and reflected signals.

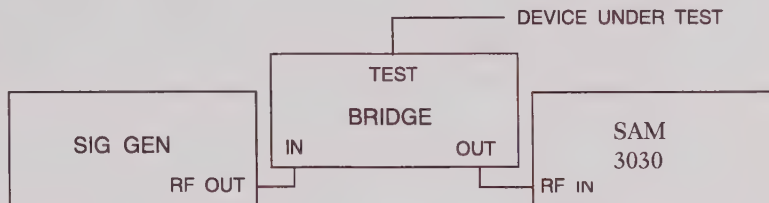
For example, if a 1 V signal were applied to a device whose input has a return loss specified at 20 dB, the reflected signal will be 20 dB lower than the original signal. Thus, 0.1 V will be reflected and 0.9 V will be transmitted. If the return loss of the device were 40 dB, 0.01 V would be reflected and 0.99 V would be transmitted.

Return loss may be measured using the SAM 3030 and a return loss bridge (Wavetek FB40-75). Using the SAM 3030's internal calibrator (55.2 MHz) enables a quick test, when a signal generator is unavailable. The first step is to connect the "Cal Out" to the bridge input, and the bridge output to the SAM 3030 RF In. Next, turn the calibrator on by pressing "SETUP", and then turn on Calibrator ON Mode by keying "ENTER". Next, activate the relative measurement mode by pressing "REL". The LCD will display "0.0 dB". Now, connect the device to be tested to the bridge test port and the return loss will be displayed.



Return Loss Test Set-up Using SAM 3030 Calibrator

Return loss may also be measured with the SAM 3030 using a return loss bridge (Wavetek FB40-75) and a signal generator (Wavetek MC-50 600). Connect the equipment as shown. With the bridge test port “open”, apply a signal at the desired frequency from the signal generator to the input of the bridge, and read the signal level at that frequency from the bridge output with the SAM 3030. Press “REL”. The top line of the LCD will display “0.0 dB”. Next, connect the device under test to the bridge test port, and the return loss will be indicated on the top line of the LCD.



Return Loss Test Set-up Using a Signal Generator

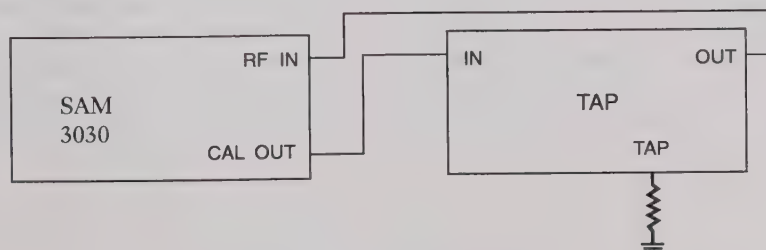
How To Test Taps And Splitters

The preferred method of testing passive components such as splitters and taps utilizes a sweep generator, RF detector, and oscilloscope; however, and operational check (adequate for most circumstances) can be performed using a SAM 3030 and a signal generator (Wavetek MC-50 600). If a signal generator is not available, the TV channel carriers themselves (coupled through appropriate amplifiers and attenuation pads) can be used as test signals.

The method is to set up a reference (0.0 dB) level by connecting the reference signal to the SAM 3030 RF In, and pressing “REL”. Then the reference signal is routed through the device under test, and the top line of the LCD will display the loss of the device. The SAM 3030 calibrator may be used for any of these tests to perform a quick go/no-go test at the calibrator frequency when a signal generator or system test point is unavailable. The calibrator is activated by pressing “SETUP”, and then activating Calibrator On Mode by keying "ENTER". The relative measurements described below are then performed by pressing “FCN” “REL”, and then inserting the device to be tested.

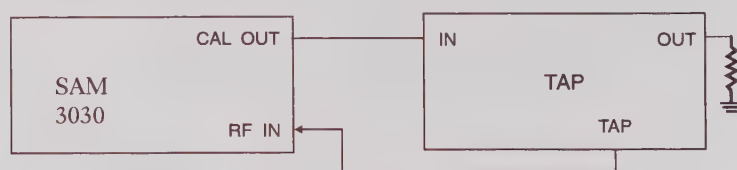
Testing Taps

There are three significant parameters to test on a tap (broadband directional coupler): through loss (input to through output); tap loss (input to tapped output); and isolation (tapped output to through output). To test through loss, first tune to the reference signal frequency and press “REL”. The top line of the LCD will display “0.0 dB”. Next, connect the signal to the tap input, terminate the tapped output, and connect the through output to the SAM 3030 RF In. The through loss will be displayed on the top line of the LCD (typically <1dB).



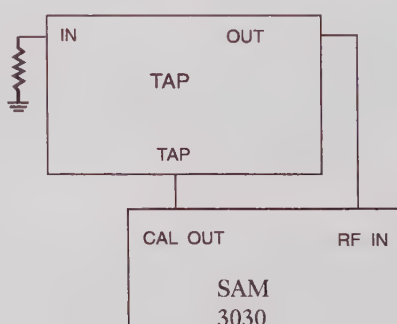
Through Loss Test Set-up (Tap)

To test tap loss, (after setting up the 0.0 dB reference with a jumper cable) connect the calibrated reference signal to the tap input, and with the through output terminated, connect the SAM 3030 to the tapped output as shown. The tap loss will be displayed on the top line of the LCD. (The tap loss should be the nominal value of the tap; i.e., a 20 dB tap should have a tap loss of 20 dB).



Tap Loss Test Set-up

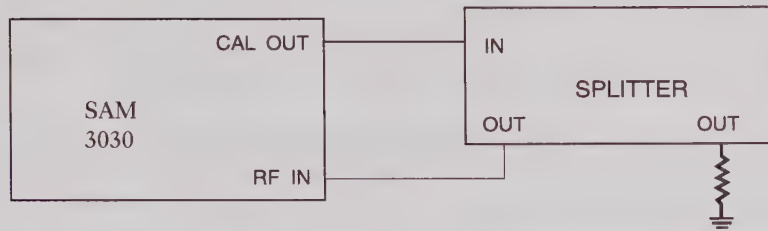
To test tap isolation, (after setting up the 0.0 dB reference with a jumper cable) connect the calibrated reference signal to the tapped output, and with the input terminated, connect the SAM 3030 to the through output as shown. The top line of the LCD will display the isolation. Ideally, no signal should reach through the output; however, in practice, the isolation is typically 20 dB plus the tap loss.



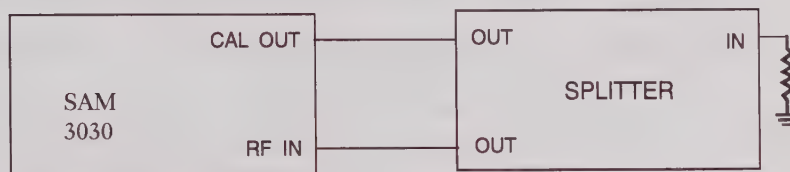
Isolation Test Set-up (Tap)

Testing Splitters

The procedures for testing splitters (broadband power dividers) are virtually identical to those for testing taps. The parameters to be measured are through loss (for each “leg” of the splitter) and isolation. The figures below show the test connections for a two-way splitter. Four-way and eight-way splitters are simply multiple two-way splitters in series. A “low-high” splitter will have different attenuation pads in each splitter “leg”. The typical through loss for each leg of a two-way splitter is 3.5 dB. For four-way and eight-way splitters, the typical through losses are 7 dB and 11 dB, respectively. Typical isolation between “legs” of a two-way splitter is 20 dB. For four-way and eight-way splitters, the isolation will vary depending on the splitter’s internal configuration, but should always be > 20 dB.



Through Loss Test Set-up (Splitter)



Isolation Test Set-up (Splitter)

A Simple Test To Verify The Operation Of Your SAM 3030

To make sure the SAM 3030 has an adequate supply of power, and to eliminate the battery as a source of failure, connect the SAM 3030 to the wall-mounted charger supplied with the meter. The red “CHARGE” LED behind the meter should be illuminated. (Please refer to “Getting Acquainted With Your SAM 3030” section of this manual if you’re unsure of the location of the items described). Turn “on” the SAM 3030. The LCD will show the frequency or channel to which the meter was last tuned, and the meter needle will show no level (no meter deflection).

Connect a test signal (calibration source) to the RF input. If the test signal is from a signal generator, tune the generator to the frequency of the SAM 3030, and set the output to -5 dBmV. The meter on the SAM 3030 should read the level of the signal. Be sure the attenuator is in the “Auto” position or set to obtain an on-scale reading. At -5 dBmV, with a 0 dB attenuator setting, the meter needle should be 5 segments below the “0” on the scale. The LCD will show the tuned frequency and -5 dBmV.

Connect a cable drop to the SAM 3030 RF In connector. Tune to channel 2, by pressing “2” then “CHN”. The LCD will show “CH 2”. Press the “V/A” key, and press the Volume UP/Down keys until the audio is set at a comfortable listening level. The audio should be clear and intelligible. Turn the volume off by pressing the volume down arrow key further.

Press “SETUP”. The meter will deflect to the “GOOD” region of the battery test scale. If the battery needs to be charged, the meter needle won’t deflect beyond the “recharge” section of the battery scale when the charger is disconnected. Please refer to the “Battery Charging Basics” section of this manual for proper charging procedures.

What To Do If Your SAM 3030 Needs Service

If you are not sure if your SAM 3030 is working properly, please go through the “How To Check Your SAM 3030’s Performance” section of this manual. If you have any question about how to use your SAM 3030, or are unsure of its operation, please call for **Applications Assistance: 1-800-622-5515**.

If your SAM 3030 needs service, please call **Customer Service: 1-800-851-1198**. Have your SAM 3030 serial number ready. Wavetek’s friendly Customer Service Representative will ask for the serial number, your address for return shipping, and a description of the problem. They will also want your name, in case the Service Technician needs to call you to discuss the problem in further detail to make a proper diagnosis.

Error Messages

If a problem exists in your LineSAM or Fiber LineSAM, one of the following messages may appear on the display. If this occurs please call - Wavetek Customer Service at 1-800-851-1198.

ERR 1: EDIT ERROR	incorrect keystroke sequence when editing frequency or channel
ERR 2: CALIBRA RANGE	the unit cannot be calibrated at the current temperature since the IF gain range is insufficient to calibrate
ERR 3: CHN NUM RANGE	a. the entered channel number is outside the range for the current channel plan b. the channel range entered for test plan definition is incorrect
ERR 4: FREQ ERROR	the test plan definition requested cannot be honored because the test plan is already in use; you must delete all sets which use the plan before you can redefine the plan
ERR 5: CHN NOT PGM	channel chosen is not programmed in the current custom channel plan
ERR 6: FREQ RANGE	frequency chosen is too high or too low for unit
ERR 7: PLAN IN USE	the test plan definition requested cannot be honored because the test plan is already in use; you must delete all sets which use the plan before you can redefine the plan
ERR 8: NOT CUSTOM PL	Pgm function was requested on a non-custom channel plan
ERR 9: HUM ERROR	Hum cannot be measured at the current temperature since the IF gain range is insufficient to measure Hum
ERR 10: NO SUB OPT	sub channel request cannot be honored because required sub option is not installed
ERR 11: NO UHF OPT	UHF channel request cannot be honored because required UHF option is not installed
ERR 12: RECHARGE BAT	the unit's internal batteries are discharged, recharge must be done before unit can be used
ERR 13: CALB MEMORY	an error was detected in the unit's calibration memory indicating internal ROM failure
ERR 14: PGM MEMORY	an error was detected in the unit's program storage memory (FAV channels, HI/LO/MID); check/re-program these

ERR 15: CUSTOM EMPTY	an attempt was made to choose a custom channel plan which has not been programmed
ERR 16: KEY INACTIVE	the key or function requested is not active in the current unit state
ERR 17: PLAN LIMIT	the limit of 100 channels per test plan has been reached and this request cannot be honored unless a selected channel is first deleted (skipped)
ERR 21: PLAN NOT DEF	the chosen test plan has not been defined via the DEFINE function
ERR 24: CUSTOM MEMRY	an error was detected in the unit's custom channel plan storage memory; check/re-program these
ERR 25: NO VIDEO CAR	no video carrier found
ERR 26: NO AUDIO CAR	no audio carrier found
ERR 27: AUD TOO LOW	audio carrier is outside the measurement range in this mode
ERR 28: VID TOO LOW	video carrier is outside the measurement range in this mode
ERR 30: VAL TOO HIGH	sweep limit entered is > 79.9

MP MASTER



MA35749



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